This invention relates to high voltage transformers. The invention is especially useful when embodied in transformers for television receivers or the like.

The high voltage used for operation of a cathode ray tube, such as in a television receiver set, ordinarily is provided in the form of pulses by an auto-transformer included in the horizontal beam deflection circuit. The high voltage appearing across the auto-transformer is rectified, and the rectified voltage is applied to the high voltage terminal of the cathode ray tube. Due to the high voltages involved, danger of arcing over to other parts of the receiver circuit and danger of corona discharge is present. To prevent these, there are used bulky shielding of the auto-transformer and careful arrangement of the conductors on which the high voltage appears. Prior art inter-connection of the high voltage rectifier and the auto-transformer involves a relatively long conductor which should be properly arranged to avoid arcing and in which sharp turns should be avoided since sharp turns are conducive to corona discharge. Not only is shielding employed with the prior art rectangular core auto-transformers to prevent arcing, but also to prevent the adverse effect on the Q of the auto-transformer by proximity to other metal parts of the television chassis.

It is an object of this invention to provide an improved auto-transformer structure suitable for use in a television high voltage circuit. It is an object of the invention to provide an auto-transformer structure which is inherently shielded whereby separate shielding is unnecessary.

It is an object of the invention to provide an auto-transformer structure which can be mounted simply and economically and in close proximity to other circuit parts with reduced danger of arcing or corona discharge and with reduced adverse effect on the Q of the auto-transformer.

It is an object of the invention to provide the combination of an auto-transformer and a high voltage rectifier in which the electrical connection between an electrode of a rectifier and the high voltage terminal of the transformer is reduced in length.

It is an object of the invention to provide an inherently shielded connection between an electrode of the rectifier and the high voltage terminal of the transformer.

It is an object of the invention to provide the combination of an auto-transformer and a rectifier in which these two elements of the circuit have less bulk than prior art transformers and rectifiers.

The auto-transformer of this invention in a preferred form comprises a relatively thin disk-like coil wound on a hollow ferrite rod. A hollow ferrite cylinder having closed ends encloses the coil and rod, the ends of the rod being integrally united with the ends of the cylinder. Connections to coil taps and to the rectifier filament supply may be taken out of the closed ferrite cylinder through ends thereof. The high voltage connection to the coil is mounted on the periphery of the coil and

The anode terminal of the high voltage rectifier may be inserted into the high voltage connection through a hole in the ferrite cylinder and in registry with the high voltage connection. The transformer may be mounted at any convenient location on the receiver chassis by means of a bolt extending through the hollow rod.

This invention may be better understood by reference to the following more detailed explanation thereof taken with the accompanying drawing, in which:

FIG. 1 is a circuit diagram of a high voltage and horizontal deflection circuit of a television receiver using a transformer embodying the invention;

FIG. 2 is a side elevation of the transformer of FIG. 1;

FIG. 3 is a section on line 3--3 of FIG. 2 of the transformer and illustrating the connection to it of a rectifier of FIG. 1.

Turning first to FIG. 1, a horizontal deflection output tube 2 is provided, the cathode 4 of which is grounded and the anode 6 of which is connected to a tap 8 of a high voltage auto-transformer winding 10. A suitable sawtooth voltage is applied to a grid 12 of output tube 2. The horizontal yoke coils 14 of a cathode ray tube 16 are connected to a pair of taps 16 and 18 on coil 10 between tap 8 thereon and an end 20 of the coil 10. The cathode 22 of a dumper tube 24 is connected to tap 25 on coil 16, tap 26 being between anode 28 and horizontal yoke tap 16, the closer of the two yoke taps. The anode 28 of the dumper tube 24 is connected to the end 29 of coil 10 through +B-boost capacitor 30 and B- is applied to the junction of anode 28 and capacitor 30. +B-boost voltage is obtained from the junction of condenser 30 and coil 10, i.e., at the end 29 of the coil 10. The anode 32 of the high voltage rectifier 34 is connected to the upper or high voltage terminal 36 of coil 10 and the cathode 30 of rectifier 34 is connected to ground through high voltage filter capacitor 40. The heater of rectifier 38 is supplied by transformer secondary winding 37. The rectified and smooth high voltage which is taken from the junction of cathode 38 and capacitor 40 is applied to the high voltage terminal 42 of a cathode ray tube 44. The circuit as thus far described is known and its operation is therefore not discussed. In FIGS. 2 and 3, to which reference is now made, the elements corresponding to those described above have been given the same reference characters as those used in FIG. 1.

The high voltage transformer 48 comprises a closed cylinder 49 of ferrite having a disk shaped winding 10 therein, surrounding a central hollow ferrite rod 50. The completed cylinder 49 is formed by abutting the lips of two like cup-shaped end members 51 and 52 each having a half of a hollow rod 50, 50' centrally located with respect to their respective cups, the rods 50 and 50' being inserted through the winding 10. The winding 10, ends 51, 52 and rods 50 and 50' are joined into a complete assembly by a bolt 54 extending through holes in the closed ends 51 and 52 of the cylinder 49 and the center hole of the rods 50 and 50'. In this assembly the ends of rods 50 and 50' are integrally joined to their respective closed ends 51 and 52 of the ferrite cylinder 49 and are centrally located therein. The cylinder and the rod, thus form a closed magnetic circuit and comprise the transformer core. A connection 20' to the end of coil 10 and connections 15', 15', 26' and 8' (which will correspond to the connections 20, 15, 26 and 8 re-
respectively of FIG. 1 when the transformer 48 is connected in a television circuit like that of FIG. 1), to the required taps on the coil 10 are taken out through the closed end 51 of the cylinder 49. A female connector 36 is attached as by taping or gluing to the periphery of the disk-like coil 10. The connector 35 is formed with a central opening 58 into which the anode terminal 60 of rectifier tube 32 may fit. A hole 62 is provided in the periphery of the cylinder core 49 so that connection can be made between the connector 36 and terminal 60 through hole 62. A loop 31 connects the end of coil 10 to the connector 35. A flexible insulating sleeve 64 is provided around the terminal 60 to guide it into place and thereafter to protect it and to additionally insulate it and the connector 36 and loop 11. If a short insulating sleeve 64 is used, the loop 11 and the exposed external surface of connector 35 should be insulated. A few turns 37 of conductor are wound around rod 50 to supply heating current for rectifier 28, the ends of the wire comprising the turns 37 extending out of cylinder 49 through an end wall thereof for connection to the rectifier heater.

The high voltage rectifier 32 here illustrated may be a Mullard of Philips tube type EV51 having a pinlike anode terminal 60 extending out of its envelope, in which case the central opening 58 of connector 36 is formed to fit terminal 60. However, the terminal 60 may be formed to fit the male cap of any suitable rectifier tube, the insulator 64 and the hole 62 being formed correspondingly. Or a solid state rectifier having a pin-like terminal such as 60 may be used instead of an electron tube type of rectifier.

The core cylinder 49 in operation has magnetic and electrostatic shielding properties. Also, the outside of the cylinder is substantially ground potential and therefore, the transformer 48 may be mounted in any convenient location on a chassis 70 as by means of the bolt 84 extending through the hole in core rods 50 and 59' and through a bracket 74 which is itself fixed to chassis 70, providing great flexibility of the location of the transformer 48.

Due to the shielding properties of the core cylinder 49, necessity for separate or additional shielding is eliminated and mounting of the transformer close to other elements of the circuit does not adversely affect the Q of the transformer. Also, the connection of the high voltage rectifier to the high voltage terminal of the transformer is as close as possible since all connecting wire has been eliminated, thereby reducing the capacity of this connection to other parts of the device in which it may be included and also eliminating any problem of arrangement of the high voltage lead or of corona produced thereby or of capacity between the lead and any other parts of the circuit, or of the possibility of any arcing between such a lead and any other parts of the circuit. Also, due to the transformer structure and due to the high voltage connection, there is provided a compact self-shielded structure of reduced overall size and volume, which may be mounted in any convenient place and which requires no lead between the transformer and the rectifier tube.

What is claimed is:

1. The combination of,
a high voltage transformer and a rectifier device hav-
in a plurality of electrodes, said transformer comprising,
a rod of magnetic material,
a coil of annular disk shape surrounding at least a por-
tion of said rod, and having a high potential end at its outer periphery and a low potential end at its inner periphery,
a wired connection to said low potential end of the coil, and a female electrical connector mounted on the outer periphery of said coil and electrically connected to said high potential end of said coil;
said rectifier device having a male electrical connector integral therewith, mounted on the exterior thereof and connected to one of said plurality of electrodes; said connectors being formed to fit one into the other, and being in direct electrical contact with each other.

2. The combination of,
a closed core high voltage transformer and a rectifier device, said transformer comprising,
a hollow cylindrical structure of magnetic material hav-
ing closed flat end walls and a peripheral wall, a hollow rod of magnetic material extending between said cylinder and rod together making up a hollow core of said transformer,
a winding of annular disk shape surrounding a portion of said rod and spaced from said end walls and said peripheral wall, and having a high potential end at its outer periphery and a low potential end at its inner periphery, a wired connection to said low potential end of said winding extending through a wall of said core, a female electrical connector mounted on the outer pe-
riphery of said winding and connected to the high potential end thereof, there being a hole in said cylindrical structure in regist-
try with said female connector, and said rectifier device having a male electrical con-
nect integral therewith, one of said connectors extending through said last-
mentioned hole,
said connectors being arranged in electrical contact with each other.

3. The combination comprising:
a transformer comprising a disk-shaped winding, en-
ergization of said transformer developing a high po-
tential at the end of said winding lying on the outer periphery thereof;
a female electrical connector mounted on the outer pe-
riphery of said winding and connected to said high potential end thereof;
and a rectifier device having a plurality of electrodes,
said rectifier device having a male electrical con-
nect integral therewith mounted on the exterior of said device and connected to one of said plurality of elec-

trodes;
said rectifier device being mounted with its male con-
nectors in mating electrical contact with the female con-
nectors of said transformer.

4. The combination comprising:
a transformer comprising a disk-shaped winding, ener-
gization of said transformer developing a high po-
tential at the end of said winding lying on the outer periphery thereof;
a female electrical connector mounted on the outer pe-
riphery of said winding and connected to said high potential end thereof;
a rectifier device having a plurality of electrodes, said rectifier device having a male electrical connector integral therewith, mounted on the exterior of said device and connected to one of said plurality of elec-
trodes, and said rectifier device being mounted with its male connector in mating, electrical contact with the female connector of said transformer;
and a hollow insulator surrounding said mating con-
nectors.

5. In a television receiver including a cathode ray tube having an electrode requiring a high unidirectional operating potential; a deflection system for said cathode ray tube comprising a deflection wave transformer incorporating a disk shaped winding, the high potential end of which lies along the outer disk periphery, and a recti-
fier device for supplying said high unidirectional operat-
ing potential to said cathode ray tube electrode in re-
response to the application of an output of said transformer to an electrode of said rectifier device;
the combination comprising:
a female electrical connector mounted on the periph-
3,20,852 5 6 ery of said winding and electrically connected to said high potential end of said winding; a male electrical connector mounted on the exterior of said rectifier device and electrically connected to said rectifier device electrode, said rectifier device being mounted in juxtaposition with said transformer in such manner that said male connector is in mating, electrical contact with said female connector; and a hollow insulator at least partially enclosing said mating connectors.

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JOHN F. BURNS, Primary Examiner.
DARRELL L. CLAY, Examiner.